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(21) International Application Number: PCT/SE92/00052 (22) International Filing Date: 28 January 1992 (28.01.92) (30) Priority data: 9100306-1                      31 January 1991 (31.01.91)      SE (71) Applicant (for all designated States except US): BEROL NOBEL AB [SE/SE]; S-444 85 Stenungsund (SE). (72) Inventors; and (75) Inventors/Applicants (for US only) : HELLSTEN, Martin [SE/SE]; Vårsåddsvägen 4, S-444 05 Ödsmål (SE). HARWIGSSON, Ian [SE/SE]; Östra Kristinelundsvägen 12 B, S-217 48 Malmö (SE).		(74) Agent: ANDERSSON, Rolf; Berol Nobel AB, S-444 85 Stenungsund (SE). (81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent), US. Published With international search report.	
(54) Title: USE OF ALKOXYLATED ALKANOLAMIDE AS FRICTION-REDUCING AGENT			
<div style="text-align: center;"> <math display="block">\begin{array}{c} \text{RCNH(A)}_n\text{H} \\ \parallel \\ \text{O} \end{array} \quad (\text{I})</math> </div>			
(57) Abstract			
<p>Use of an alkoxyated alkanolamide of general formula (I), wherein R is a hydrocarbon group having 7-35 carbon atoms, preferably 9-23 carbon atoms, A is an alkyleneoxy group having 2-4 carbon atoms, and n is 2-20, preferably 3-12, for producing a water-base liquid system with reduced flow resistance between the flowing, water-base liquid system and a solid surface.</p>			

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USE OF ALKOXYLATED ALKANOLAMIDE AS FRICTION-  
REDUCING AGENT

The present invention relates to the use of an  
5 alkoxyated alkanolamide in a water-base system for reducing the flow resistance between a solid surface and the water-base liquid system.

It is well-known that the flow resistance of a liquid in a conduit is largely due to the turbulence that arises  
10 at the conduit wall. However, much of this turbulence can be prevented by adding to the liquid a sufficient amount of elongate particles. The size of these particles may vary within several orders of magnitude, from severed textile fibres, water-soluble chain molecules down to  
15 cylindrical surfactant micelles, i.e. within the range of  $10^{-7}$ - $10^{-2}$  m. The reduction of the pressure drop that can be achieved by such additions is considerable, and has, in commercial hot-water systems, been assessed at 75%, which involves corresponding savings in supplied pump energy or,  
20 alternatively, permits further extension of the distributive network with the same pump installations.

In most cases, the addition of fibres is inconvenient, since various filters often are incorporated in circulating liquid systems, and the water-soluble chain  
25 polymers are torn by the high shear forces in the pumps and thereby lose their effect.

Surfactants with the ability to form extremely long, cylindrical micelles have, in recent years, attracted a great interest as friction-reducing additives to systems  
30 with circulating water, especially those destined for heat or cold distribution.

An important reason for this interest is that, although one desires to maintain a laminar flow in the conduits, one wishes at the same time to have turbulence  
35 in the heat exchangers to achieve therein a high heat transfer per unit area.

As may easily be understood, fibres or chain polymers are unable to provide this double function which, however, can be achieved with rod-shaped micelles, since the flow rate (the Reynold's number) usually is much higher in the heat exchangers than in the conduit.

The rod-shaped micelles are distinguished by operating in a fairly disorderly fashion at low Reynold's numbers (below  $10^4$ ) and having no or only a very slight effect on the flow resistance.

At higher Reynold's numbers (above  $10^4$ ), the micelles are paralleled and result in a friction reduction very close to that which is theoretically possible.

At even higher Reynold's numbers (e.g. above  $10^5$ ), the shear forces in the liquid become so high that the micelles start to get torn and the friction-reducing effect rapidly decreases as the Reynold's numbers increase.

The range of Reynold's numbers within which the surface-active agents have a maximum friction-reducing effect is heavily dependent on the concentration, the range increasing with the concentration.

By choosing the right concentration of surface-active agents and suitable flow rates in tubings and heat exchangers, it is thus possible to establish a laminar flow in the tubes and turbulence in the heat exchangers. Thus, the dimensions of both the tubes and the exchangers can be kept at a low level, or the number of pump stations, and consequently the pump work, can alternatively be reduced while retaining the same tubular dimensions.

The surface-active agents hitherto used as friction-reducing additives to circulating water systems - mainly destined for heat or cold distribution - are all of the type alkyltrimethyl ammonium salicylate of the chemical formula

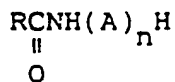
wherein R represents a long alkyl chain which has 16-22 carbon atoms and which may either be saturated or contain one or more double bonds.

This type of surface-active agent functions satisfactorily already at a concentration of 0.5-1 g/l, but is degraded very slowly, both aerobically and anaerobically, and further is highly toxic to marine organisms.

Since heat-distribution systems for small houses usually suffer from important leaks (it is estimated that in one year 60-100% of the water leaks out), it follows that the added chemicals end up in the ground water and in various fresh-water recipients. This combination of low biodegradability and high toxicity is a fundamental criterion for a product injurious to the environment.

Thus, there is a general demand for surface-active agents which are less harmful to the environment but which have the same excellent ability as the quaternary ammonium compounds described above to reduce the flow resistance in circulating water systems.

It has now surprisingly been found that a long since well-known type of non-ionic surface-active agents, namely alkoxyated alkanolamides, are capable of forming long cylindrical micelles. In flow tests in water-base systems, they had a friction-reducing effect well up to the effect achieved by the above-mentioned alkyltrimethyl ammonium salicylate. To be more specific, the invention relates to the use of an alkoxyated alkanolamide of the general formula



wherein R is a hydrocarbon group having 7-35 carbon atoms, preferably 9-23 carbon atoms, A is an alkyleneoxy group having 2-4 carbon atoms, and n is 2-20, preferably 3-12, for producing a water-base liquid system with reduced flow resistance between the liquid water-base system and a

solid surface. By 'water-base' is meant that at least 50% by weight, preferably at least 90% by weight, of the water-base liquid system consists of water. The alkoxylated alkanolamide is especially suited for use in water-base systems flowing in long conduits, e.g. circulating water systems for heat or cold distribution. The amount of alkoxylated alkanolamide may vary within wide limits depending on the conditions, but generally is 100-10,000 g/m<sup>3</sup> of the water-base system.

10       The alkoxylated alkanolamide can be produced by amidation of a carboxylic acid of the formula RCOOH, wherein R has the meaning stated above, with an alkanolamine of the formula NHAH, wherein A has the meaning stated above, or by aminolysis of a corresponding triglyceride or methyl ester with the above-mentioned alkanolamine followed by  
15       alkoxylation of the resulting amide. The alkoxylation may be carried out in the presence of an alkaline catalyst at a temperature of 150-180°C.

It is especially suitable to carry out the alkoxylation in the presence of a tertiary amine lacking protons that react with alkylene oxide, or an alkylene-oxide-quaternised derivative of the tertiary amine at a temperature ranging from room temperature to 120°C, which results in high yields of the desired product. Suitable  
20       tertiary amines include trimethylamine, triethylamine, tributylamine, dimethyloctylamine, tetramethylethylenediamine, dimethyl coconut amine, tristearyl amine, dimethyl piperazine and diazabicyclooctane.

The alkoxylation may comprise ethoxylation, propoxylation, addition of propylene oxide and ethylene oxide in blocks, simultaneous addition of ethylene oxide and propylene oxide, or a combination thereof. The ethylene oxide conveniently amounts to at least 50 mole% of the added alkylene oxide. To use only ethoxylation is preferred.

30       The alkoxylation may comprise ethoxylation, propoxylation, addition of propylene oxide and ethylene oxide in blocks, simultaneous addition of ethylene oxide and propylene oxide, or a combination thereof. The ethylene oxide conveniently amounts to at least 50 mole% of the added alkylene oxide. To use only ethoxylation is preferred.  
35       The carboxylic acids of the formula RCOOH, wherein R has the meaning stated above, may be aliphatic, aromatic as well as cyclo-aliphatic. Suitable carboxylic acids

include the aliphatic carboxylic acids in which the hydrocarbon part may be saturated or unsaturated, straight or branched. To use conventional fatty acids is especially preferred.

Suitable alkoxyated alkanolamides include the following specific examples:

$$\begin{array}{c} \text{O} \\ \parallel \\ \text{RCNH}(\text{C}_2\text{H}_4\text{O})_4\text{H}, \end{array}$$
 wherein RC is derived from rape oil fatty acid,

10 
$$\begin{array}{c} \text{O} \\ \parallel \\ \text{RCNH}(\text{C}_2\text{H}_4\text{O})_7\text{H}, \end{array}$$
 wherein RC is derived from rape oil fatty acid,

15 
$$\begin{array}{c} \text{O} \\ \parallel \\ \text{RCNHC}_3\text{H}_6\text{O}(\text{C}_2\text{H}_4\text{O})_3\text{H}, \end{array}$$
 wherein RC is derived from lauric acid,

$$\begin{array}{c} \text{O} \\ \parallel \\ \text{RCNH}(\text{C}_2\text{H}_4\text{O})_4\text{H}, \end{array}$$
 wherein RC is derived from lauric acid,

20 
$$\begin{array}{c} \text{O} \\ \parallel \\ \text{RCNHC}_2\text{H}_4\text{O}(\text{A})_4\text{H}, \end{array}$$
 wherein RC is derived from stearic acid, and

the group A is random added from equal mole parts of ethylene oxide and propylene oxide

25 
$$\begin{array}{c} \text{O} \\ \parallel \\ \text{RCNHC}_4\text{H}_8\text{O}(\text{C}_2\text{H}_4\text{O})_{10}\text{H}, \end{array}$$
 wherein RC is derived from linolenic acid.

The choice of chain length and degree of unsaturation is determined by the temperature range in which the alkoxyated alkanolamide is to operate. A higher temperature requires a larger hydrocarbon group and less unsaturation. The choice of the degree of alkoxylation is determined by the size and degree of saturation of the hydrocarbon group as well as by the temperature. Whether

30 the right degree of alkoxylation has been reached is easily established by determining the cloud point of the

35

alkoxylated alkanolamide in a 1% solution in the water-base system. Below the cloud point, i.e. the alkoxylated alkanolamide is solved in the water-base system, the ability of the alkoxylated alkanolamide to reduce the flow resistance increases as the temperature increases, whereas this ability decreases at higher temperatures, at which the alkoxylated alkanolamide is precipitated. Thus, the degree of alkoxylation and the alkyleneoxy group present should be selected in such a manner that the cloud point of the alkoxylated alkanolamide is equal to or slightly below the temperature prevailing in the water-base system at laminar flow, e.g. at Reynold's numbers between  $10^4$  and  $10^5$ . When the temperature of the water-base system varies considerably, e.g. when the system is used as heating medium in long tubings, the cloud point of the alkoxylated alkanolamide should at least exceed the lowest temperature prevailing in the water-base system at laminar flow. Preferably, the cloud point should exceed the highest temperature of the water-base system at laminar flow. Adjustment to the desired cloud point may conveniently be performed by mixing alkoxylated alkanolamides of different cloud points. Such mixtures may also be advantageous when the temperature in the water system at laminar flow varies considerably.

When using the water-base system for cold distribution, it is essential that the Krafft point of the alkoxylated alkanolamide, i.e. the temperature at which the alkoxylated alkanolamide starts to crystallise in the water-base system, is below the lowest temperature in the water-base system. The Krafft point may be decreased by selecting fatty acids with shorter alkyl chains and/or unsaturated fatty acids. A higher degree of ethylation as well as incorporation of soluble salts in the water-base system will also decrease the Krafft point. When used as a cooling medium, the temperature of the water-base system is suitably below  $30^{\circ}\text{C}$ , preferably below  $20^{\circ}\text{C}$ .

Apart from the alkoxylated alkanolamide, the water-



base system may contain a number of conventional components, such as rust-preventing agents, anti-freeze, and bactericides. The system may also include solubilisers, such as diethylene glycol monobutyl ethers, which may  
5 affect the cloud point of the alkoxylated alkanolamides in the water-base system quite considerably.

The present invention will now be further illustrated with the aid of the following Example.

Exemple

10 Measurements were carried out in a 6-m tube loop consisting of two straight and stainless tubes (3 m each), one tube having an inner diameter of 8 mm and the other having an inner diameter of 10 mm. Water was pumped through the tube loop by a centrifugal pump, which was  
15 driven by a frequency-controlled motor, for continuous adjustment of the flow rate, which was determined by a rotameter.

The straight parts of the tube loop had outlets which, with the aid of valves, could in turn be connected  
20 to a differential pressure gauge whose other side was all the time connected to a reference point in the tube loop. Further, the tube loop was heat-insulated, and the suction side of the pump was connected to a thermostatically controlled container with a volume of 20 l, to which the  
25 return flow from the tube loop was directed.

After the testing compound had been added and the aqueous solution had been thermostatically controlled, measurements began at low flow rates, and the pressure difference from two points on the 10-mm tube and three  
30 points on the 8-mm tube were measured for each flow rate. The pressure differences thus measured were then converted into Moody's friction factor  $\gamma$  and are shown in the Table below as a function of the Reynold's number  $Re$ .

8

$$Y = 2D.P_{diff}/V^2.L.d$$

$$Re = D.V.d/u$$

D = tube diameter

V = flow rates

5 L = tube length over which the pressure difference  
P<sub>diff</sub> was measured

d = density of the liquid

u = viscosity of the liquid

The Table also states the corresponding Prandtl num-  
10 ber and Virk number. The former corresponds to the fric-  
tion factor of water only, i.e. with turbulence, and the  
latter corresponds to flow without turbulence.

One of the following compounds was added as testing  
compound A Cetyl trimethyl ammonium salicylate

15 B C<sub>12-14</sub> alcohol + 6 EO

C 50% by weight of rape oil fatty acid ethanolamide  
+ 3 EO

50% by weight of rape oil fatty acid ethanolamide  
+ 6 EO

20 (The cloud point of the mixture was 56°C in  
water)

The following results were obtained.

Table 1

25 Compound A, addition of 1000 ppm, temperature of 50°C

Reynold's number	Moody's friction fractor . 10 <sup>3</sup>				
	10 <sup>4</sup>	2x10 <sup>4</sup>	4x10 <sup>4</sup>	6x10 <sup>4</sup>	8x10 <sup>4</sup>
30 Prandtl number	30	24	22	21	20
10 mm	35	15	8.0	6.0	17
8 mm	30	12	6.0	6.0	18
Virk number	10	8	5.5	4.5	3.0

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Table 2

Compound B, addition of 20 g/l, temperature of 80°C,  
Moody's friction factor

5	Reynold's number	Moody's friction factor . $10^3$				
		$10^4$	$2 \times 10^4$	$4 \times 10^4$	$6 \times 10^4$	$8 \times 10^4$
	Prandtl number	30	24	22	21	20
	10 mm	-	14	14	13	13
	8 mm	-	12	15	14	14
10	Virk number	10	8.0	5.5	4.5	3.0

Table 3

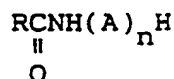
Compound C, addition of 6000 ppm, temperature of 25°C,  
Moody's friction factor

15	Reynold's number	Moody's friction factor . $10^3$				
		$10^4$	$2 \times 10^4$	$4 \times 10^4$	$6 \times 10^4$	$8 \times 10^4$
	Prandtl number	30	24	22	21	20
	10 mm	15	9	6.0	5.0	10
	8 mm	20	10	6.5	11	15
20	Virk number	10	8.0	5.5	4.5	3

As is apparent from these results, the invention gives a friction reduction down to the theoretically possible level (the Virk line), in analogy with prior-art results with alkyltrimethyl ammonium salicylate, and this is not possible with common non-ionic surface-active agents of the type fatty alcohol ethoxylate. Compared with the prior-art quaternary ammonium compounds, the friction-reducing agent according to the invention is advantageous in that it is much less toxic to water organisms and is biologically degraded much faster, both aerobically and anaerobically. The friction-reducing agent according to the invention may thus be used as a friction-reducing additive also to heat-distribution systems where there is a certain amount of leakage.

## CLAIMS

1. Use of an alkoxyated alkanolamide of the general  
5 formula



wherein R is a hydrocarbon group having 7-35 carbon atoms,  
10 preferably 9-23 carbon atoms, A is an alkyleneoxy group  
having 2-4 carbon atoms, and n is 2-20, preferably 3-12,  
for producing a water-base liquid system with reduced flow  
resistance between the flowing, water-base liquid system  
and a solid surface.

- 15 2. Use as claimed in claim 1, c h a r a c t e r -  
i s e d in that n is so chosen that the alkoxyated  
alkanolamide, in the concentration in which it is used in  
the water-base system, has a cloud point which is higher  
than the lowest temperature of the water-base system  
20 at laminar flow.

3. Use as claimed in claim 2, c h a r a c t e r -  
i s e d in that the cloud point is higher than the  
highest temperature of the water-base system.

4. Use as claimed in claim 1, 2 or 3, c h a r a c -  
25 t e r i s e d in that the water-base system is a hot-  
water system with a temperature exceeding 60°C.

5. Use as claimed in claim 1, 2 or 3, c h a r a c -  
t e r i s e d in that the water-base system is a cooling  
medium with a temperature below 30°C.

- 30 6. Use as claimed in any one of claims 1-5, c h a r -  
a c t e r i s e d in that the alkoxyated alkanolamide  
is added in an amount of 100-10,000 g/cm<sup>3</sup> of the water-base  
system.

7. Use as claimed in any one of claims 1-6, c h a r -  
35 a c t e r i s e d in that at least half of the alkyleneoxy  
groups are ethyleneoxy groups.

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8. Use as claimed in claim 7, c h a r a c t e r i s -  
e d in that A is an ethyleneoxy group.

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# INTERNATIONAL SEARCH REPORT

International Application No **PCT/SE 92/00052**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC <b>IPC5: C 09 K 3/00, C 07 C 233/17, F 15 D 1/02, C 10 M 105/04</b>																	
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched<sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border: 1px solid black;">Classification System</th> <th style="border: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border: 1px solid black; vertical-align: top; padding: 5px;"><b>IPC5</b></td> <td style="border: 1px solid black; vertical-align: top; padding: 5px;"><b>C 07 C; C 09 K; C 10 M; F 15 D</b></td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched<sup>8</sup></div> <p style="padding: 5px;"><b>SE,DK,FI,NO classes as above</b></p>			Classification System	Classification Symbols	<b>IPC5</b>	<b>C 07 C; C 09 K; C 10 M; F 15 D</b>											
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<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; padding: 5px;">Category *</th> <th style="width: 60%; padding: 5px;">Citation of Document,<sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 30%; padding: 5px;">Relevant to Claim No.<sup>13</sup></th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>A</b></td> <td style="padding: 5px;"> <b>EP, A1, 0147489 (MOBIL OIL CORPORATION)</b>            10 July 1985, see page 1, line 1 -            line 15; claim 1  <div style="text-align: center;">--</div> </td> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>1-8</b></td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>A</b></td> <td style="padding: 5px;"> <b>EP, A2, 0146097 (HOECHST AKTIENGESELLSCHAFT)</b>            26 June 1985, see page 1, line 1 -            line 3; claim 1  <div style="text-align: center;">--</div> </td> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>1-8</b></td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>A</b></td> <td style="padding: 5px;"> <b>SE, B, 425849 (L'OREAL) 15 November 1982,</b>            see page 6 - page 7; claim 1  <div style="text-align: center;">--</div> </td> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>1-8</b></td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>A</b></td> <td style="padding: 5px;"> <b>Patent Abstracts of Japan, Vol 8, No 187, C240,</b>            abstract of JP 59- 80643, publ 1984-05-10            (RAION K.K.)  <div style="text-align: center;">--</div> </td> <td style="text-align: center; vertical-align: top; padding: 5px;"><b>1-8</b></td> </tr> </tbody> </table>			Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	<b>A</b>	<b>EP, A1, 0147489 (MOBIL OIL CORPORATION)</b> 10 July 1985, see page 1, line 1 - line 15; claim 1 <div style="text-align: center;">--</div>	<b>1-8</b>	<b>A</b>	<b>EP, A2, 0146097 (HOECHST AKTIENGESELLSCHAFT)</b> 26 June 1985, see page 1, line 1 - line 3; claim 1 <div style="text-align: center;">--</div>	<b>1-8</b>	<b>A</b>	<b>SE, B, 425849 (L'OREAL) 15 November 1982,</b> see page 6 - page 7; claim 1 <div style="text-align: center;">--</div>	<b>1-8</b>	<b>A</b>	<b>Patent Abstracts of Japan, Vol 8, No 187, C240,</b> abstract of JP 59- 80643, publ 1984-05-10 (RAION K.K.) <div style="text-align: center;">--</div>	<b>1-8</b>
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<b>A</b>	<b>Patent Abstracts of Japan, Vol 8, No 187, C240,</b> abstract of JP 59- 80643, publ 1984-05-10 (RAION K.K.) <div style="text-align: center;">--</div>	<b>1-8</b>															
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><b>* Special categories of cited documents: <sup>10</sup></b></p> <p><b>"A"</b> document defining the general state of the art which is not considered to be of particular relevance</p> <p><b>"E"</b> earlier document but published on or after the international filing date</p> <p><b>"L"</b> document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p><b>"O"</b> document referring to an oral disclosure, use, exhibition or other means</p> <p><b>"P"</b> document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p><b>"T"</b> later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p><b>"X"</b> document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p><b>"Y"</b> document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p><b>"&amp;"</b> document member of the same patent family</p> </div> </div>																	
<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: 1px solid black; padding: 5px;">           Date of the Actual Completion of the International Search  <b>28th April 1992</b> </td> <td style="width: 50%; border: 1px solid black; padding: 5px;">           Date of Mailing of this International Search Report  <b>1992 -05- 0 6</b> </td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">           International Searching Authority  <div style="text-align: center; padding-top: 10px;"><b>SWEDISH PATENT OFFICE</b></div> </td> <td style="border: 1px solid black; padding: 5px;">           Signature of Authorized Officer<sup>14</sup>  <div style="text-align: center; padding-top: 10px;">   <b>Bengt Christensson</b> </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <b>28th April 1992</b>	Date of Mailing of this International Search Report <b>1992 -05- 0 6</b>	International Searching Authority <div style="text-align: center; padding-top: 10px;"><b>SWEDISH PATENT OFFICE</b></div>	Signature of Authorized Officer <sup>14</sup> <div style="text-align: center; padding-top: 10px;">   <b>Bengt Christensson</b> </div>											
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International Searching Authority <div style="text-align: center; padding-top: 10px;"><b>SWEDISH PATENT OFFICE</b></div>	Signature of Authorized Officer <sup>14</sup> <div style="text-align: center; padding-top: 10px;">   <b>Bengt Christensson</b> </div>																

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	GB, A, 2093478 (CINCINNATI MILACRON INC) 2 September 1982, see page 11 - page 14 --	1-8
A	DE, C2, 3050184 (CINCINNATI MILACRON INC) 14 December 1989, see page 2, line 49; claim 1 --	1-8
A	SE, B, 363092 (ROHM AND HAAS COMPANY) 7 January 1974, see claim 1 --	1-8
A	GB, A, 1145740 (DISTILLERS CHEMICALS AND PLASTICS LIMITED) 19 March 1969, see column 1, line 13; claim 1 -- -----	1-8

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 92/00052**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 28/03/92  
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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